**DOI:** 10.14744/cm.2026.76094
Compreh Med 2026;18(Suppl. 1):32-37

RESEARCH ARTICLE

# Evaluation of Physicians' Knowledge and Proficiency in The Management of Anaphylaxis and The Use of Adrenaline Auto-Injectors

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## ABSTRACT

**Objective:** This study was conducted to evaluate the knowledge levels of specialist and general practitioners working at Şırnak State Hospital regarding anaphylaxis treatment and their ability to correctly use an adrenaline auto-injector.

**Materials and Methods:** A questionnaire measuring knowledge levels regarding anaphylaxis treatment was administered to the physicians. The participating physicians were asked to demonstrate the use of the adrenaline auto-injector. Data obtained from the evaluation results were recorded. The use of the adrenaline auto-injector was then explained to the physicians again.

**Results:** A total of 108 physicians participated in the study, 60 of whom were specialists (55.6%) and 48 were general practitioners (44.4%). Of the participating physicians, 87 (80.6%) correctly knew that adrenaline was the first drug to be administered in anaphylaxis. Of the 108 physicians, 94 (87%) correctly knew the dose of adrenaline. Of the 108 physicians surveyed, 101 (93.5%) correctly knew the route of adrenaline administration, and 92 (85.2%) knew where it should be administered. The steps involved in administering auto-injectors were also evaluated, and incorrect administration steps were identified. The physicians' adrenaline auto-injector administration practices were also assessed after the training.

**Conclusion:** In conclusion, improvements in the administration of adrenaline auto-injectors by physicians, the development of clinical skills, improvement in physicians' knowledge regarding anaphylaxis and adrenaline administration, and increased training in this area are necessary. It is crucial that physicians have the confidence and competence to administer adrenaline auto-injectors safely.

**Keywords:** Adrenaline, allergy, anaphylaxis, auto-injector, treatment

**How to cite this article**: Özkaya M, Çelik Tuğlu H. Evaluation of Physicians' Knowledge and Proficiency in The Management of Anaphylaxis and The Use of Adrenaline Auto-Injectors. Compreh Med 2026;18(Suppl. 1):32-37.

## INTRODUCTION

Anaphylaxis is a life-threatening hypersensitivity reaction that begins acutely and involves multiple organ systems.[1] The signs and symptoms of anaphylaxis are varied and can affect the skin, respiratory and gastrointestinal systems, and cardiovascular system.[2] The recommended treatment for anaphylaxis is usually intramuscular administration of adrenaline in the community.[3] Since it is impossible to predict when anaphylaxis will occur in individuals who have experienced it, an adrenaline auto-injector (AAI) is prescribed to the patient. Patients, their parents, and even their teachers should be adequately informed about how to recognize anaphylaxis and how to administer the AAI.[4] Recognizing anaphylaxis and administering adrenaline early are crucial. Delays in the treatment of anaphylaxis can occur, especially in anaphylaxis cases.[5] As a result of delays in administering adrenaline to the patient, the risk of mortality increases.[6] Due to insufficient recognition of the symptoms and signs of anaphylaxis, anxiety and fear experienced during administration, and unfamiliarity with auto-injectors, the prompt use of AAIs may be limited.[7]

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**Received date:** 13.05.2026
**Revised date:** 12.07.2026
**Accepted date:** 22.07.2026
**Online date:** 14.10.2026

Comprehensive Medicine published by Kare Media.
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Although previous studies, including several reports from Türkiye, have evaluated physicians' knowledge of anaphylaxis, data assessing both theoretical knowledge and practical adrenaline auto-injector (AAI) administration skills, together with the impact of structured hands-on training, remain limited. Therefore, this study aimed to identify gaps in physicians' knowledge and practical skills regarding anaphylaxis management and AAI use while also evaluating the effectiveness of immediate practical training.

## MATERIALS and METHODS

The study was conducted at the Pediatric Allergy and Immunology Outpatient Clinic of Şırnak State Hospital. Ethics committee approval was obtained from Şırnak University on November 10, 2025, with approval number E-74546226-622.01-150011. The study was conducted in accordance with the principles of the Declaration of Helsinki. Specialist physicians and general practitioners who agreed to participate were consecutively enrolled in the study. No additional exclusion criteria were applied. To evaluate physicians' knowledge and practical skills regarding anaphylaxis and adrenaline auto-injector (AAI) use, participants completed a structured questionnaire and were then asked to demonstrate the use of an AAI using a trainer device. A standardized checklist was developed to assess each step of AAI administration (Table 1). Each participant's performance was evaluated by a pediatric allergy and immunology specialist. Following the baseline assessment, participants received standardized face-to-face training, including recognition of anaphylaxis, indications for adrenaline administration, correct AAI administration technique, and hands-on demonstration using the trainer device. Participants were then immediately re-evaluated using the same standardized checklist. Errors during AAI administration were recorded before and after the educational intervention. The questionnaire was developed based on previously published studies and current international anaphylaxis guidelines.[3] Before implementation, the content was reviewed by pediatric allergy and immunology specialists to ensure content validity.

### Statistical Analysis

Statistical analysis of the data was performed using IBM SPSS Statistics, version 22.0 (IBM Corp., Armonk, NY, USA). In this study, categorical data were expressed as numbers and percentages. Statistical methods were not applied to groups with univariate variables. The relationship between categorical variables was evaluated using the $\chi^2$ test for pairwise group comparisons. For all results, $p<0.05$ was considered statistically significant.

### Ethics Committee Approval

This study was approved by the Şırnak University Ethics Committee with decision number E-74546226-622.01-150011 dated 10.11.2025.

## RESULTS

A total of 108 physicians (100%) were included in the study. Of the participants, 60 (55.6%) were specialist physicians and 48 (44.4%) were general practitioners. Overall, 70.4% (n=76) of the physicians correctly defined anaphylaxis, whereas 29.6% (n=32) defined it incorrectly. In addition, 80.6% (n=87) of the physicians correctly identified adrenaline as the treatment for anaphylaxis, whereas 19.4% (n=21) answered incorrectly. When asked about the first drug to be administered in anaphylaxis, 80.6% (n=87) of the physicians answered adrenaline, 14.8% (n=16) answered corticosteroids, and 4.6% (n=5) answered antihistamines (Table 2).

Regarding the adrenaline dose, 87% (n=94) of the participants gave the correct answer, whereas 13% (n=14) gave an incorrect answer. Regarding the muscle into which adrenaline should be administered, 85.2% (n=92) responded vastus lateralis, 13.9% (n=15) deltoid, and 0.9% (n=1) gluteus maximus. Regarding the route of adrenaline administration, 93.5% (n=101) reported intramuscular administration and 6.5% (n=7) reported intravenous administration (Table 2).

A total of 24.1% (n=26) of the participants stated that they had previously received training on anaphylaxis, whereas 75.9% (n=82) stated that they had not. The percentage of those who reported having previously administered an AAI was 5.6% (n=6), whereas 94.4% (n=102) stated that they had not. In response to the question, "Which auto-injector is prescribed for which weight?", 38% (n=41) gave the correct answer, whereas 62% (n=67) gave an incorrect answer. The percentage of those who knew how to correctly use the auto-injector was 39.8% (n=43), whereas 60.2% (n=65) did not. The percentage of physicians who were confident in managing anaphylaxis was 30.6% (n=33), whereas 69.4% (n=75) were not confident (Table 2).

**Table 1. Steps for administering adrenaline auto-injector**

| Steps |
|---|
| 1. The adrenaline auto-injector is grasped by the wide white body. |
| 2. First, the cap numbered 1 at the bottom is removed. |
| 3. Then, the locking cap numbered 2 at the top is removed. |
| 4. The auto-injector is applied to the vastus lateralis |
| 5. Wait 10 seconds after application. |
| 6. A light massage is applied after the procedure. |

**Table 2. Characteristics of physicians**

| Variable | Total: 108 (100%) n (%) | Variable | Total: 108 (100%) n (%) |
|---|---|---|---|
| Doctor | | What is the route of adrenaline administration? | |
| Specialist Physician | 60 (55.6) | Intravenous | 7 (6.5) |
| General Practitioner | 48 (44.4) | Intramuscular | 101 (93.5) |
| Defining anaphylaxis | | Has received prior training in anaphylaxis? | |
| Correctly | 76 (70.4) | Yes | 26 (24.1) |
| Incorrectly | 32 (29.6) | No | 82 (75.9) |
| Intended use of adrenaline in clinical practice | | Has he/she administered adrenaline auto-injector (AAI) before? | |
| Yes | 87 (80.6) | Yes | 6 (5.6) |
| No | 21 (19.4) | No | 102 (94.4) |
| Knowledge of the first-line treatment for anaphylaxis | 16 (14.8) | Which adrenaline auto-injector (AAI) is prescribed for what weight? | |
| Corticosteroid | 5 (4.6) | Knows | 41 (38) |
| Antihistamine | 87 (80.6) | Doesn't know | 67 (62) |
| Adrenaline | | Does he/she know the correct use of adrenaline auto-injector (AAI) ? | |
| Adrenaline dose | | Yes | 43 (39.8) |
| Correctly | 94 (87) | No | 65 (60.2) |
| Incorrectly | 14 (13) | Is he/she confident in managing anaphylaxis? | |
| Which muscle is adrenaline administered to? | | Yes | 33 (30.6) |
| Deltoid | 15 (13.9) | No | 75 (69.4) |
| Vastus lateralis | 92 (85.2) | | |
| Gluteus maximus | 1 (0.9) | | |

**Table 3. Mistakes made during adrenaline auto-injector administration steps**

| Steps | Step taken incorrectly before training | Steps taken incorrectly after training |
|---|---|---|
| 1. Grasp the adrenaline auto-injector by its wide white body. | 0 | 0 |
| 2. First, remove the cap number 1 at the bottom. | 10 | 0 |
| 3. Then remove the locking cap number 2 at the top. | 18 | 3 |
| 4. Apply the auto-injector to the vastus lateralis. | 16 | 0 |
| 5. Wait 10 seconds after application. | 30 | 4 |
| 6. Apply a light massage after the procedure. | 38 | 9 |

When comparing the number of incorrect steps in AAI administration before and after training, the number of errors decreased from 10 to 0 for the step of "removing cap number 1 first," from 18 to 3 for the step of "removing the upper locking cap number 2," and from 16 to 0 for the step of "applying the auto-injector to the vastus lateralis muscle." Errors in the step of "waiting 10 seconds after application" decreased from 30 to 4, and errors in the step of "applying a light massage after the procedure" decreased from 38 to 9. No errors were detected before or after training in the step of "grasping the auto-injector by the wide white body" (0–0) (Table 3).

When comparing specialist physicians and general practitioners, the rate of correctly identifying the definition of anaphylaxis was 81.7% (n=49) among specialists and 56.3% (n=27) among general practitioners, and the difference was statistically significant (p=0.004). The rate of correctly identifying the drug to be administered in anaphylaxis was 95.0% (n=57) among specialists and 62.5% (n=30) among general

**Table 4. Comparison of specialist physicians and general practitioners**

| | Specialist physician n (%) | General practitioner n (%) | p |
|---|---|---|---|
| Accurate definition of anaphylaxis | 49 (81.7) | 27 (56.3) | 0.004 |
| Correct identification of first-line drug to be administered in anaphylaxis | 57 (95.0) | 30 (62.5) | <0.001 |
| Knowledge of correct adrenaline dose | 55 (91.7) | 39 (81.3) | 0.109 |
| Knowledge of correct injection site | 56 (93.3) | 37 (77.1) | 0.015 |
| Knowledge of correct administration route | 59 (98.3) | 42 (87.5) | 0.029 |
| Previous anaphylaxis training | 18 (30.0) | 8 (16.7) | 0.107 |
| Prior history of AAI administration | 6 (10.0) | 0 (0.0) | 0.024 |
| Knowledge of weight-based AAI prescription | 34 (56.7) | 7 (14.6) | <0.001 |
| Knowledge of correct AAI use | 32 (53.3) | 11 (22.9) | 0.001 |
| Confidence in anaphylaxis management | 21 (35.0) | 12 (25.0) | 0.262 |

AAI: Adrenaline auto-injector

practitioners (p<0.001). The rates of correctly identifying the adrenaline dose were 91.7% (n=55) among specialists and 81.3% (n=39) among general practitioners, and the difference was not statistically significant (p=0.109). The rate of correctly identifying the muscle into which adrenaline should be administered was 93.3% (n=56) among specialists and 77.1% (n=37) among general practitioners (p=0.015). The rate of correctly identifying the route of administration was 98.3% (n=59) among specialists and 87.5% (n=42) among general practitioners (p=0.029). The rates of prior anaphylaxis training were 30.0% (n=18) among specialists and 16.7% (n=8) among general practitioners, and the difference was not statistically significant (p=0.107). Prior AAI administration was reported by 10.0% (n=6) of specialists and 0% (n=0) of general practitioners (p=0.024). The rate of correctly knowing how to prescribe an AAI was 56.7% (n=34) among specialists and 14.6% (n=7) among general practitioners (p<0.001), whereas the rate of correctly knowing how to use an AAI was 53.3% (n=32) among specialists and 22.9% (n=11) among general practitioners (p=0.001). Self-confidence rates in anaphylaxis management were 35.0% (n=21) among specialists and 25.0% (n=12) among general practitioners, and the difference was not statistically significant (p=0.262) (Table 4).

## DISCUSSION

Our study aimed to evaluate physicians' knowledge of emergency intervention for anaphylaxis, their confidence in using adrenaline auto-injectors (AAIs), their competence in performing the correct steps required for AAI administration, and their administration techniques. In our study, the knowledge of general practitioners and specialist physicians at Şırnak State Hospital regarding the use of adrenaline as the first-line drug in anaphylaxis, its route of administration, dosage, site of administration, and the steps involved in using an auto-injector was evaluated. Some deficiencies were identified among physicians regarding their knowledge and skills in AAI administration.

In our study, 70.4% of physicians correctly defined anaphylaxis, 80.6% correctly identified adrenaline as the first-line treatment, and 87.0% correctly identified the appropriate adrenaline dose. However, only 38.0% correctly identified the appropriate weight-based prescription of AAIs. In contrast, a large-scale study by Cambaz Kurt and Kutlu[8] reported that although more than 90% of pediatricians in Türkiye recognized the signs of anaphylactic reactions, only 53.1% knew the correct auto-injector dose. Another study conducted among physicians showed that 93% of physicians chose epinephrine as the first-line treatment for anaphylaxis, but only 49% knew the correct auto-injector dose.[9] These data are consistent with our study findings: physicians generally recognize anaphylaxis and the need for adrenaline treatment, but they lack knowledge about auto-injector dosing and administration. Administering the correct treatment at the correct dose without delay is vital in anaphylaxis. It is known that delayed or incorrect administration of adrenaline increases the risk of a fatal outcome.[10] Song et al.[11] also reported that rapid intramuscular administration of adrenaline is life-saving and that auto-injectors are insufficiently used in practice. In our study, 93.5% of physicians correctly identified the intramuscular route of adrenaline administration.

Studies evaluating physicians' knowledge and practical skills regarding anaphylaxis and AAI use remain limited. Recent studies from Türkiye have also demonstrated im-

portant deficiencies in physicians' knowledge and practical competence. Deligöz et al.[10] reported that although most resident physicians correctly identified adrenaline as the first-line treatment, knowledge regarding anaphylaxis diagnosis, adrenaline dose, route of administration, and patient follow-up remained suboptimal. Emeksiz et al.[12] demonstrated significant improvements in both theoretical knowledge and practical AAI administration skills among pediatric residents after structured training. Similarly, Akova et al.[13] reported persistent deficiencies in residents' knowledge of anaphylaxis despite generally adequate awareness of first-line adrenaline treatment. In our study, only 39.8% of physicians correctly demonstrated AAI use before training, whereas almost all participants corrected their errors after training. One possible reason for the low rate of correct AAI use in our study may be that general practitioners had not yet received specialty training. General practitioners (22.9%) demonstrated significantly lower knowledge of correct AAI use than specialists (53.3%). This finding suggests that limited experience and lack of specialty training may negatively affect preparedness for anaphylaxis management. Arga et al.[14] also reported that many general practitioners were unable to use an AAI correctly and emphasized that current educational methods were insufficient. The fact that 94.4% of the participants in our study had never previously administered an AAI further supports this finding. The observed reduction in administration errors after training suggests that structured practical education may improve physicians' practical AAI administration skills. Similarly, Arga et al.[14] suggested that combining practical sessions with theoretical instruction significantly improves correct AAI use.

In this study, the steps in which AAI use was performed incorrectly were evaluated. The most frequent error was failure to massage the application site after the procedure. In addition, simple but important deficiencies were identified, such as removing the upper and lower caps of the auto-injector in the incorrect order or, in some cases, removing only the lower cap. After the physicians' mistakes were explained using the demo auto-injector, almost all participants were able to perform the procedure correctly and completely after training. Similarly, in a study conducted among pediatric residents when the older AAI model was in use, improvements were observed after training.[15] It should not be forgotten that AAI use may appear easy, but even simple procedures can become complicated in emergency situations. It is particularly important for physicians, patients, and parents caring for children to know how to use an auto-injector correctly. For this reason, training should be repeated regularly. It is important for physicians to provide this training to patients and their families from the outset and reinforce it at every visit.

A major strength of this study is the simultaneous evaluation of both physicians' theoretical knowledge and practical AAI administration skills. In addition, the immediate assessment before and after standardized hands-on training allowed objective evaluation of the effectiveness of the educational intervention. Furthermore, the inclusion of both specialist physicians and general practitioners enabled comparisons across different levels of clinical experience.

This study has several limitations. First, this was a single-center study using a convenience sample of physicians from a secondary care hospital, which may limit the generalizability of the findings. Second, participants were evaluated immediately after training; therefore, long-term retention of knowledge and practical skills could not be assessed. Previous studies have shown that retention of AAI skills declines over time. In one study, the time elapsed since the last AAI training was the most important factor affecting correct AAI use, and training repeated every six months was associated with a 96% probability of correct AAI use.[16] Similarly, a study conducted among intern physicians demonstrated a decline in AAI use skills six months after training.[17] Finally, participation was voluntary, introducing the possibility of selection bias. These findings emphasize the importance of regular reinforcement of practical AAI training for physicians and other healthcare professionals.

In light of these data, the importance of early intervention and correct auto-injector administration in the management of anaphylaxis is once again emphasized. The need for training healthcare professionals in auto-injector use has also been consistently emphasized in the literature.[16]

## CONCLUSION

This study identified important deficiencies in physicians' knowledge and practical skills regarding anaphylaxis management and the use of adrenaline auto-injectors (AAIs). Although fundamental knowledge, including the correct adrenaline dose and route of administration, was generally adequate, correct step-by-step AAI administration remained insufficient. General practitioners demonstrated significantly lower levels of knowledge and practical skills than specialists. The observed improvement after standardized hands-on training suggests that practical educational interventions may improve physicians' preparedness and practical skills in AAI administration. Given the life-threatening nature of anaphylaxis, regular, structured, hands-on AAI training should be incorporated into continuing medical education to improve physicians' preparedness, confidence, and ultimately, patient safety.

## Disclosures

**Ethics Committee Approval:** The study was approved by the Şırnak University Ethics Committee (No: E-74546226-622.01-150011, Date: 10/11/2025).

**Informed Consent:** Written informed consents were obtained from patients who participated in this study.

**Conflict of Interest Statement:** The authors declare that there is no conflict of interest.

**Funding:** The authors declared that this study received no financial support.

**Use of AI for Writing Assistance:** The authors declared that artificial intelligence was not used in the study.

**Author Contributions:** Concept – M.Ö., H.Ç.T.; Design – M.Ö., H.Ç.T.; Supervision – M.Ö., H.Ç.T.; Funding – M.Ö., H.Ç.T.; Materials – M.Ö., H.Ç.T.; Data collection and/or processing – M.Ö., H.Ç.T.; Data analysis and/or interpretation – M.Ö., H.Ç.T.; Literature search – M.Ö., H.Ç.T.; Writing – M.Ö.; Critical review – M.Ö., H.Ç.T.

**Acknowledgments:** We would like to thank and express our gratitude to the medical professionals for their valuable contributions to this study.

**Peer-review:** Externally peer-reviewed.

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